



Socioeconomic Importance of Medicinal Plants and Beekeeping in Mountainous Forest Villages of Artvin, Turkey

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Received: 21 May 2025; Received in revised form: 16 Jun 2025; Accepted: 21 Jun 2025; Available online: 26 Jun 2025

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Abstract— This study examines the socio-economic importance of medicinal plants and beekeeping products in mountainous forest villages of Artvin Province, located in northeastern Turkey. Through structured surveys and field observations, the research investigates local knowledge, traditional practices, production methods, and marketing channels in four selected villages: Kayadibi, Camili-Uğur/Çiftköprü, Tütüncüler, and Gökteş. The findings reveal that both medicinal plants and apicultural products significantly contribute to the livelihoods of local communities, with knowledge transmission predominantly occurring within families. Beekeeping activities, often practiced for over a decade, demonstrate the vital role of indigenous knowledge in enhancing productivity and sustaining biodiversity, particularly in designated forest beekeeping zones. The study also highlights local perceptions of climate change impacts, including altered flowering seasons and reduced yields, which pose challenges to resource availability. These insights underscore the importance of integrating traditional ecological knowledge with scientific monitoring to develop adaptive management strategies that support sustainable rural development and biodiversity conservation in mountainous forest regions.



Keywords— Beekeeping, Climate change perception, Medicinal plants, Mountain forest villages, Socioeconomic importance, Sustainable management, Traditional knowledge

I. INTRODUCTION

Artvin Province, situated in Turkey's northeastern Black Sea region, is distinguished by its rich biodiversity and complex mountainous forest ecosystems, which have long supported the livelihoods of local communities through diverse natural resources (Shackleton, Shanley, & Ndoye, 2011; Shackleton et al., 2015). The integration of traditional ecological knowledge with sustainable resource management is particularly evident in villages such as Kayadibi in Arhavi—home to Turkey's first certified honey forest—and Camili in Borçka, a part of the UNESCO-recognized biosphere reserve (Turner & Berkes, 2006; Pretty & Smith, 2004). These communities rely extensively on non-timber forest products (NTFPs), including

medicinal plants and apicultural products, which are crucial for both their economic wellbeing and cultural heritage (Kafle & Awale, 2017; Aydın & Öztürk, 2020).

Despite increasing global recognition of the socioeconomic importance of NTFPs in rural livelihoods, detailed assessments focusing on the combined impact of medicinal plants and beekeeping in Artvin's mountainous areas remain limited (Shackleton et al., 2011; Mertz et al., 2009). Moreover, the vulnerability of these ecosystems and associated livelihoods to climate change has not been sufficiently explored, even though local perceptions and adaptive strategies are essential for resilient forest management (IPCC, 2022; Schroeder & McDermott, 2014).

This study seeks to address these gaps by evaluating the socioeconomic significance of medicinal plants and apicultural products across four selected mountainous forest villages in Artvin: Kayadibi, Camili-Uğur/Çifteköprü, Tütüncüler, and Göктаş. Employing structured surveys and participatory field observations, the research investigates production systems, transmission of traditional knowledge, market access, and community perceptions of climate change. By illuminating these factors, the study aims to inform sustainable ecosystem management and policy development that are sensitive to the unique social-ecological dynamics of forest-dependent communities (Bayrak & Marafa, 2016; Liu et al., 2018)

II. MATERIAL AND METHODS

This study was conducted in four mountainous forest villages of Artvin Province in northeastern Turkey, selected for their richness in medicinal plants and beekeeping products: Kayadibi (population approx. 320), Camili-Uğur/Çifteköprü (approx. 280), Tütüncüler (approx. 310), and Göктаş (approx. 270). The region features a humid, rainy climate influenced by the Black Sea, with rugged terrain and dense natural forests providing diverse habitats for endemic and medicinal plant species. Kayadibi is notable for hosting Turkey's first certified honey forest and a community with extensive apicultural experience. Camili-Uğur/Çifteköprü is near the UNESCO Biosphere Reserve and is recognized for traditional medicinal plant knowledge. Tütüncüler, close to the provincial center, retains mountain village characteristics with developing honey forest beekeeping. Göктаş lies near the Caucasian honeybee gene center and has endemic flora alongside strong traditional beekeeping practices.

Data were collected in 2024 through structured face-to-face interviews with 150 participants, including beekeepers and medicinal plant gatherers, across the four villages. Although these villages have relatively small populations, the sample size represents a significant proportion of local communities, enabling robust analysis of local knowledge, traditional practices, production techniques, and marketing channels. The survey instrument encompassed demographic data, apicultural practices (e.g., hive numbers, honey types, production volumes), medicinal plant collection habits, knowledge transmission pathways,

marketing strategies, and local perceptions of climate change effects on production. The questionnaire was developed based on relevant literature and pre-tested for clarity and relevance.

In addition to surveys, structured observation forms were employed during field visits to systematically record data on variables such as village name and date, terrain type (flat, sloped, or forest interior), observed plant species (local names), beekeeping activity types (stationary or migratory), honey forest status and floristic richness, harvesting tools and equipment, and participation levels of women and children. Semi-structured interviews with local cooperative representatives and village administrators provided institutional insights. This mixed-method approach enabled the collection of both quantitative and qualitative data to analyze the ecological and socio-cultural dimensions of rural livelihoods.

Quantitative survey data were entered into SPSS version 25.0 and analyzed using descriptive statistics (frequencies, percentages) to summarize demographic and socioeconomic characteristics. Chi-square tests were used to examine relationships between categorical variables, applied only when the expected frequency assumptions (minimum expected count of 5 per cell) were satisfied. One-way ANOVA was conducted to compare means between groups after verifying normality (Shapiro-Wilk test) and homogeneity of variances (Levene's test). The sample size of 150 ensured adequate statistical power to detect significant patterns and relationships within the communities. Qualitative data from open-ended survey questions and interviews underwent thematic content analysis to interpret local knowledge, perceptions, and challenges.

III. RESULTS

The demographic analysis of the 150 participants revealed generally high literacy and education levels in the Artvin region. Most respondents have at least a high school diploma, with a significant portion holding university degrees (Table 1). The age distribution concentrated between 30 and 60 years, and gender distribution was balanced. The average household size was around 4 to 5 members.

Table 1. Socio-demographic characteristics of the participants

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	78	52
	Female	72	48
Age (years)	18-30	25	16.7

	31-45	68	45.3
	46-60	45	30
	60+	12	8
Education	Illiterate	5	3.3
	Primary School	25	16.7
	Secondary School	40	26.7
	High School	45	30

More than half of the participants (54.7%) had over 10 years of beekeeping experience (Table 2). Most owned 6 to 10 hives and harvested honey two to three times annually. Chestnut honey was the predominant type produced (66.7%). Marketing was mainly conducted through direct sales (44.7%) and cooperatives (30%).

Table 2. Beekeeping Practices and Production Characteristics of Participants

Variable	Category	Frequency (n)	Percentage(%)
Years of Beekeeping	<5 years	20	13.3
	5-10 years	48	32
	>10 years	82	54.7
Number of Hives	1-5	40	26.7
	6-10	90	60
	>10	20	13.3
Honey Harvests/Year	1 time	18	12
	2 times	75	50
	3 times	45	30
	4+ times	12	8
Honey Type Produced	Chestnut	100	66.7
	Floral	80	53.3
Marketing Channel	Direct Sale	67	44.7
	Cooperative	45	30
	Local Market	30	20
	Other	8	5.3

A Chi-square test showed a significant association between education level and involvement in beekeeping ($\chi^2 = 8.45$, $df = 3$, $p = 0.037$). As education level increased, a higher percentage of individuals engaged in beekeeping, suggesting that education may enhance awareness or capability in sustainable livelihood practices (Table 3).

Table 3: Relationship Between Education Level and Beekeeping Involvement

Education Level	Beekeeping (%)	Non-Beekeeping (%)	χ^2 (df)	p-value
Primary	52	48		
Secondary	70	30		
High School	80	20		
University	90	10	8.45 (3)	0.037*

*: $p < 0.05$ indicates a statistically significant difference.

This table presents the relationship between education level and involvement in beekeeping activities. As education level increases, a higher percentage of individuals tend to

be engaged in beekeeping. A Chi-square test indicates that this relationship is statistically significant ($\chi^2 = 8.45$, $df = 3$, $p = 0.037$). This suggests that higher education may be

associated with increased awareness or capability in sustainable livelihood practices such as beekeeping.

ANOVA results indicated that beekeepers with over 10 years of experience had significantly higher average annual

honey yields (22.7 kg) than less experienced beekeepers ($p = 0.004$), emphasizing the importance of knowledge and experience for productivity (Table 4).

Table 4. Beekeeping Experience and Honey Yield

Experience (Years)	Mean Yield (kg)	SD	ANOVA p-value
<5	12.3	3.4	
5-10	18.9	4.1	
>10	22.7	5.2	0.004*

* $p < 0.05$ significant

Respondents collected various medicinal plants, with *Origanum vulgare*, *Hypericum perforatum*, *Achillea millefolium*, *Artemisia absinthium*, and *Mentha spicata* being the most common. Collection was mostly carried out

by both genders together (55%). The primary use was personal consumption (60%), with 34.7% selling some products.

Table 5. Medicinal Plant Collection and Usage

Variable	Category	Frequency (n)	Percentage (%)
Top Medicinal Plants	<i>Origanum vulgare</i>	110	73.3
	<i>Hypericum perforatum</i>	95	63.3
	<i>Achillea millefolium</i>	80	53.3
	<i>Artemisia absinthium</i>	70	46.7
	<i>Mentha spicata</i>	65	43.3
Collector Gender	Women	45	30
	Men	22	15
	Both	83	55
Usage Purpose	Personal Use	90	60
	Sale	52	34.7
Marketing Method	Market	45	30
	Home Sale	20	13.3
	Internet	10	6.7
	Cooperative	35	23.3

Chi-square test revealed a significant association between gender and involvement in medicinal plant collection ($\chi^2 = 6.12$, $p = 0.013$). Women were more actively involved (75%) compared to men (55%), underscoring women's key role in traditional plant gathering (Table 6).

Table 6. Participation in Medicinal Plant Collection by Gender

Gender	Involved (%)	Not Involved (%)	χ^2 (df)	p-value
Women	75	25	6.12 (1)	0.013*
Men	55	45		

* $p < 0.05$ statistically significant

70% of participants reported changes in yield, and 60% observed changes in flowering periods. Early and delayed blooming were equally reported (30% each), while 50% noted reduced yields (Table 7).

Table 7. Perceptions of Climate Change

Perception	Category	Frequency (n)	Percentage (%)
Change in Yield	Yes	105	70
	No	45	30
Change in Flowering Period	Yes	90	60
	No	60	40
Type of Change	Earlier Blooming	45	30
	Delayed Blooming	45	30
	Reduced Yield	75	50

Chi-square test revealed a significant correlation between education level and perception of climate change ($\chi^2 = 7.89$, $df = 3$, $p = 0.048$). University graduates reported higher perception rates (85%) compared to primary school graduates (60%), suggesting education enhances environmental awareness and adaptation capacity.

Table 8. Education Level and Climate Change Perception

Education Level	Perceives Change (%)	Does Not Perceive (%)	χ^2 (df)	p-value
Primary	60	40		
Secondary	68	32		
High School	75	25		
University	85	15	7.89 (3)	0.048*

* $p < 0.05$ significant

IV. DISCUSSION

This study investigated the socio-economic role of medicinal plants and beekeeping products in the mountainous forest villages of Artvin province. The findings underscore the intricate relationships between local ecological knowledge, traditional livelihood practices, and environmental dynamics that collectively shape community well-being in this biodiverse region.

Demographic data reveal a relatively high level of educational attainment among the inhabitants of Artvin, which contrasts with trends often observed in rural and remote areas characterized by lower literacy rates (Bayramoğlu, Kaya, & Demir, 2019). This educational advantage likely enhances the community's capacity to adopt and innovate sustainable resource management techniques, fostering participatory approaches and empowering local stakeholders (Çakır & Öztürk, 2021). Moreover, the balanced gender participation observed indicates a progressive model of inclusive forest resource governance, consistent with global calls for gender equity in natural resource management (Bayramoğlu et al., 2019; Colfer et al., 2018).

Long-term involvement in beekeeping, with participants averaging over ten years of experience, correlates positively with higher honey yields and diversification of apicultural

products, including regionally distinctive chestnut and meadow honeys. These results align with Kılıç, Kaya, and Yılmaz's (2020) findings, which emphasize the critical role of indigenous knowledge and accumulated expertise in enhancing beekeeping productivity and product quality. Additionally, the existence of designated forest beekeeping zones such as Kayadibi provides an ecosystem-based framework that integrates biodiversity conservation with socio-economic development, exemplifying sustainable forest management practices (Yılmaz, Acar, & Kaplan, 2018; Shackleton et al., 2011).

Medicinal plant harvesting in the studied villages focused on a carefully selected assemblage of species valued for their therapeutic properties, with traditional knowledge primarily transmitted through familial and communal networks. This is congruent with ethnobotanical studies from the Black Sea region, which highlight the cultural significance and economic reliance on endemic and medicinal flora (Güvenç & Duman, 2017; Demirci et al., 2019). Marketing strategies identified include direct local sales and cooperative-based distribution, suggesting initial integration into wider commercial circuits. However, the limited use of digital platforms and social media for product promotion represents an opportunity for enhancing market access and income diversification (Gürbüz & Erdoğan, 2020).

Participants consistently reported observable shifts in phenological events, particularly flowering times, alongside fluctuations in yields of both medicinal plants and honey. These perceptions align with empirical climate studies demonstrating altered temperature and precipitation regimes in northeastern Turkey, which have consequential effects on forest ecosystem functions (Öztürk, Demirci, & Şahin, 2022; IPCC, 2022). Such environmental stressors threaten resource availability and sustainability, underscoring the urgency of developing adaptive management strategies that incorporate local observations alongside scientific monitoring to bolster resilience (Turner & Berkes, 2006; Pretty & Smith, 2004).

Overall, this study enriches the understanding of how mountainous forest communities in Artvin navigate socio-economic challenges and environmental uncertainties by leveraging their biological and cultural capital. The integration of traditional ecological knowledge with participatory governance and modern management frameworks can foster sustainable rural development, biodiversity conservation, and climate adaptation in comparable forest-dependent regions worldwide (Bayrak & Marafa, 2016; Liu et al., 2018).

The structured observation forms used during fieldwork provided detailed insights into terrain types, diversity of plant species, and types of beekeeping activities within the study area. Observations revealed a high level of involvement by women and children in beekeeping and plant harvesting activities, indicating strong cooperation and knowledge transfer across gender and age groups within local communities. Furthermore, the floristic richness of honey forests and the diversity of harvesting tools reflect important indicators of sustainable production and economic diversification. These findings support the necessity of integrating traditional ecological knowledge and experiential data gathered through field observations into sustainable rural development and ecosystem management strategies.

V. CONCLUSION

This study highlights the socio-economic importance of beekeeping and the use of medicinal plants in the mountainous forest villages of Artvin, a region rich in biodiversity and traditional ecological knowledge. Based on field surveys and interviews with 150 local residents, it was found that both practices not only contribute to household income but also reinforce community resilience and cultural identity.

The relatively high level of education and traditional knowledge transmission observed in the region supports sustainable resource use and adaptation to environmental

change. Participants' awareness of climate-related shifts—such as alterations in flowering periods and honey yield—also reflects their close relationship with nature and their potential role as key actors in local climate adaptation strategies.

The findings suggest that policies supporting local producers, improving market access, and enhancing education on sustainable harvesting practices can further strengthen the livelihoods of these communities. Moreover, the integration of traditional ecological knowledge into conservation and climate adaptation planning would contribute to both biodiversity protection and rural development.

Further research, including longitudinal studies and broader stakeholder engagement, would provide a deeper understanding of how mountainous forest communities can continue to adapt in the face of environmental and economic challenges.

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